The gaps between healthcare service and building design: a state of the art review

Lacunas entre projetos dos serviços de saúde e da edificação para saúde: revisão do estado da arte

Patrícia Tzortzopoulos
Ricardo Codinhoto
Mike Kagioglou
John Rooke
Lauri Koskela

Abstract

Healthcare buildings are designed to achieve diverse objectives, ranging from providing appropriate environments where care can be delivered to communities to increasing operational efficiency and improving patient flows and the patient experience. Improvements in operational efficiency should result from state-of-the-art buildings, more appropriate layouts, departmental adjacencies, efficient clinical and business processes and enhanced information systems. However, complexities around requirements and stakeholders management may prevent the achievement of such objectives. The aim of this article is to identify and understand how healthcare services (re)design and building design can be integrated to facilitate increased performance both in terms of service delivery and future changes. Findings indicate that current approaches and innovation are restricted due to functional barriers in the design process, and that there is a need to support the development of operations driven design through time (e.g. flexible and durable) that satisfies diverse needs.

Keywords: Design. Healthcare service. Buildings. Operations Management.

Resumo

Os edifícios hospitalares tem diversos objetivos, dentre os quais a provisão de um ambiente apropriado à realização dos serviços de saúde, que contribua para o aumento da eficiência destes serviços e para a melhoria do fluxo de pacientes e da experiência dos mesmos. A melhoria na eficiência dos serviços está relacionada a edifícios modernos, com melhor layout e adjacências entre departamentos, bem como a processos clínicos eficientes e sistemas de informação adequados. No entanto, muitas vezes esses objetivos não são atingidos devido à complexidade dos requisitos de projeto e da gestão dos intervenientes. O presente artigo tem como objetivo buscar entender, através da literatura existente, como os processos de projeto dos serviços de saúde e da edificação para saúde podem ser melhor integrados, e como a melhoria do desempenho dos serviços esta relacionada à flexibilidade de adaptação da edificação em relação a futuras alterações ou mudanças. Os resultados indicam que barreiras funcionais no processo de projeto restringem tal integração, assim como a adoção de soluções inovadoras. Além disto, existe a necessidade de uma abordagem que apóie o desenvolvimento integrado dos projetos dos serviços e da edificação com foco nas questões operacionais (e.g. flexibilidade e durabilidade) que satisfaçam diversas necessidades ao longo do tempo.

***Keywords**: Projeto. Serviço de saúde. Edifícios. Requirements. Gestão de operações.*

Patrícia Tzortzopoulos
School of the Built Environment
University of Salford
4th Floor Maxwell Building
Salford, UK
M4 5WT
Tel.: +44 (0) 161 295-4284
E-mail:
p.tzortzopoulos@salford.ac.uk

Ricardo Codinhoto
School of the Built Environment
University of Salford
Tel.: +44 (0) 161 295-3507
E-mail:
r.codinhoto@salford.ac.uk

Mike Kagioglou
School of the Built Environment
University of Salford
Tel.: +44 (0) 161 295-3855
E-mail:
m.kagioglou@salford.ac.uk

John Rooke
School of the Built Environment
University of Salford
Tel.: +44 (0)161 295-6344
E-mail: j.rooke@salford.ac.uk

Lauri Koskela
School of the Built Environment
University of Salford
+44 (0) 161 295-6378
E-mail:
l.j.koskela@salford.ac.uk

Recebido em 12.02.09
Aceito em 28.03.09

Introduction

Healthcare involves providing care and supporting well being through treatment, prevention and education. The delivery process is subject to regular change due to myriad forces that range from political influences and tensions to medical and service innovations. In this context, the importance of appropriate buildings in which healthcare can be delivered has been widely recognised (EVANS; MCCOY, 1998; ULRICH *et al*., 2004).

Additionally, many authors have argued that concepts originally developed to improve efficiency and effectiveness of manufacturing processes can also be applied to improve service delivery (BUTLER; LEONG; EVERETT, 1996; MANGO; SHAPIRO, 2001; LI; BENTON; LEONG, 2002; HEAD, 2003; CHASE; APTE, 2007). Such argument is based on the premise that problems that arise in the delivery of healthcare are similar in many ways to traditional operations management problems (BRANDEAU; SAINFORT; PIERSKALLA, 2004). In fact, the original concept of operations management is being extended to incorporate production and service delivery, through what is referred to as the product-service paradigm (OLIVIA; KALLENBERG, 2003).

Building design should support new ways of working, contributing to redesigning care around the patient and delivering patient-focused environments (LAWSON, 2004; FRANCIS, 2002; GESLER *et al*., 2004). Design should also enable flexibility and adaptability to adapt to future changes, focus on the impacts of the surroundings on the patients and staff (PATI; HARVEY; CASON, 2008) and provide positive contributions to urban areas. This requires an alignment between healthcare service delivery and building design.

However, the interactions between the design of healthcare services and that of buildings do not seem to be recognised or properly understood. Past research pointed out problems in the delivery of primary healthcare facilities due to poor linkages between service and building design (TZORTZOPOULOS *et al.*, 2006). Furthermore, inexperienced construction clients, such as healthcare professionals have difficulties in understanding design and construction, and therefore in providing appropriate information at the right time to support these activities (COOPER; JONES, 1995; BARRETT; STANLEY, 1999). Conflicting requirements are commonplace, and decision making structures tend to be complex (CAMPOBASSO; HOSKING, 2004; CODINHOTO *et al*., 2009).

Three areas of knowledge are investigated to provide new theoretical insights on design for operational efficiency and effectiveness: operations management, service operations management and healthcare service operations. Such literature domains have been structured around a generic model shown in Figure 1, which aims to provide a holistic and systematic perspective on the integration of service and building design.

This model argues that building design and healthcare service delivery should be planned and executed in an integrated fashion. Such integration supports value generation, e.g. the establishment of streamlined services which are delivered within appropriate buildings, improving patient and staff experience and supporting operational efficiency. The main research question is:

How can service and building design be more appropriately integrated?

This paper is organised around the three conceptual areas described in Figure 1. The last section of the paper sets out conclusions and sub-questions which are guiding current research.

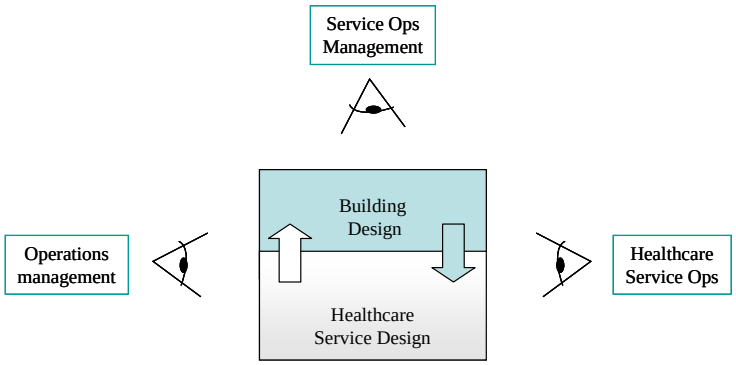

Figure 1 - **Innovative holistic design solutions**

Operations Management (OM)

OM[1] focuses on understanding and improving processes, identifying problems and route causes, making waste and inefficiencies visible, supporting appropriate value generation and enabling organisational learning (LIKER, 2004). Its principles have been adopted in manufacturing, construction and healthcare aiming at increasing the efficiency and effectiveness of the production and delivery of goods and services (KOSKELA, 2000; HEAD, 2003; DAVIS; HEINEKE, 2005; CHASE; APTE, 2007).

Many companies are currently undergoing a paradigm shift from product delivery to through-life service support. Therefore, the separation between goods and services has become somewhat of an artificial distinction today (BRYSON; DANIELS; WARF, 2004). The shift applies across a range of different sectors, including defence, aerospace and construction. In healthcare, this is often implemented through Public Private Partnerships (PPPs) which involve design, construction as well as facilities management over periods of 25-30 years. Therefore, the focus of OM is on product development, physical production as well as service delivery.

The theoretical standpoint for this research is based on the TFV (Transformation, Flow and Value generation) theory proposed by Koskela (2000) and Koskela and Howell (2008). Koskela (2000) has proposed the integration of the three different approaches, regarding is as a theory of production.

The first is the value generation model. This theory can be traced back to Aristotle in his suggestion of the method of analysis and synthesis. The basic idea is to start from ends, find the means, realise them and demonstrate that they fulfil the ends (KOSKELA; HOWELL, 2008). However, it is contended that the model has not reached the sophistication it should deserve, and there hasn't been clear theoretical links between the seminal work of Aristotle and more recent work on areas such as quality management or design science (KOSKELA; HOWELL, 2008).

The second, transformation model, regards production as the transformation of inputs into outputs in an atemporal way. This model is very generic and simple, and has been widely used both in research and practice to understand the production of physical goods as well as information (e.g. design). However, it describes production itself as a 'black box' and abstracts time away, therefore presenting shortcomings.

The third is the flow theory of production, in which a temporal view of production is taken. Production is understood as the flow of materials and information through time between different stakeholders. Queuing theory provides a model for this theory, which is often associated with lean production templates.

Noteworthy is the fact that although these theories compete through their respective production templates, are almost never competing directly, i.e. they are not discussed simultaneously (KOSKELA; KAGIOGLOU, 2005; KOSKELA; HOWELL, 2008).

Design for operational efficiency should focus on reducing waste and increasing value generation in building design and service delivery. In this context, value implies streamlined, effective services delivered in appropriate buildings. Similarly, design should also aim at achieving decreased loss of value due to gaps and distortion in requirements or missing validation and verification. The understanding of means for reduction of waste and increase in value generation through design can be achieved through investigating the processes through which healthcare services and environments are envisioned, planned, developed and delivered. From this thinking, a research questions is posed:

How developments in hospitals are defined, assessed and executed? How are requirements for such projects defined? Which stakeholders are involved? How these are managed?

Service Operations Management

Service operations management is concerned with delivering services to the customers or users and, as such, it involves understanding needs, managing the processes that deliver the service, ensuring objectives are met and process improvement is sought (JOHNSTON; CLARK, 2005). Services are "[. . .] interpersonal and intangible in nature, are produced and consumed simultaneously and are co-produced [. . .]" with the customer, being fundamentally different from the production of physical products (DUBE; JOHNSON; RENAGHAN, 1999; BERTRAND; DE VRIES, 2005; CHASE; APTE, 2007).

The service concept involves the consideration and design of all the elements of a service from

[1] Also referred to Production and Operations Management

the perspective of the buyer and seller, or, in the case of healthcare, patient and provider (ROTH; MENOR, 2003). Building layout, décor, supporting equipment and technology are considered core elements in this context. Other core service elements include facilitating goods (e.g. forms), facilitating information (e.g. diagnostics), explicit services (e.g. a consultation) and implicit services (e.g. comfort, well-being) (ROTH; MENOR, 2003).

The literature proposes models to support the planning, design implementation and management of services operations. Some of these are briefly described below. Service blueprint is a mapping technique for visualising service systems. It describes in a snapshot form an essentially dynamic phenomenon (SHOSTACK, 1984; 1987). The use of blueprints help the service creation process so as to identify problems before they happen, and also to test the quality of services being offered (MANGO; SHAPIRO, 2001; CHASE; APTE, 2007). Service blueprints may be used to map healthcare processes, describing possible scenarios. Such blueprints could inform the design of built environments to allow for efficiency and support innovation.

The customer contact model describes that the potential efficiency of a service system is a function of the degree of customer contact entailed in the creation of the service (CHASE, 1978). More specifically, the less direct contact the customer has with the service system, the greater is the potential of the system to operate at peak efficiency. Conversely, where direct customer contact is high, the smaller is the potential to achieve high levels of efficiency.

A related concept is the front and back office services (JOHNSTON; CLARK, 2005), described in Figure 2. Front-office processes deal directly with customers and tend to be visible to them. Back-office processes operate at a distance from customers and tend to be largely invisible to them, and are frequently more efficient as a result. Customers tend to inject a greater degree of variability of demand when they are able to interact with the people involved in the service production process.

This model of provides interesting insights regarding how the patient influences healthcare delivery. The separation of back and front-office services can support the achievement of better environments for patients as well as efficiency in healthcare delivery. For example, an orthopaedic clinic could be designed so that the circulation of patients is separated from support services like plaster, X rays or scans. This would allow for a calm patient environment and more efficient use of equipment and staff.

Finally, the 'experience economy' model argues that services are undergoing a transformation from the traditional concept of service transaction to one of an experience (FITZSIMMONS; FITZSIMMONS, 2004). It suggests that as services become more like commodities, experience emerges as the next step in the progression of economic value. This model relates to the concept of the *patient experience*, which has been at the forefront of many initiatives across the UK National Health Service (NHS) (BOURN, 2006). This demonstrates the recognition of the importance of patient values, emotions and judgements in the delivery of healthcare. Therefore, value in healthcare processes is very much related to intangible patient perceptions. Healthcare value is also more closely related to the quality of care and dignity than to the output of the process itself, e.g. even though the objective is to heal patients, this is not always possible.

Rationalisation and productivity improvement in healthcare are very important questions and will always be a challenge for the service operations field. It is interesting to note that none of the models described above explicitly address built environment considerations as having a direct influence over service delivery. It is however important to understand which types of infrastructure, equipment, and workforce decisions are critical to achieve the commonly acknowledged goal of providing quality health service at a reasonable cost (LI; BENTON; LEONG, 2002). Therefore, a research question is posed:

Which building design decisions are more likely to influence service effectiveness?

Healthcare Operations Management

Healthcare Operations Management has been defined as the design, planning and control of all of the steps necessary to provide a healthcare service for a client (VISSERS; BEECH, 2005). Therefore, it "[. . .] is concerned with identifying the needs of clients, usually patients, and designing and delivering services to meet their needs in the most effective and efficient manner [. . .]".

According to De Vries, Bertrand and Vissers (1999), the continuum of health care delivery

includes, vertically, from general practitioners and primary care to highly specialised care by university hospitals, and horizontally from acute care to psychiatric care, care for disabled and care for the elderly. Roth and Menor (2003) describe that most service management problems are fuzzy and unstructured, multidimensional and complex.

Such dimensions of healthcare delivery clearly impact the built environment. People's homes are part of the care continuum as it is where self care happens. Care at home has a growing role as populations are better informed, becoming 'expert' patients. Primary and community care is aimed to be delivered through 'health neighbourhoods', providing care and education integrated with local services e.g. libraries or sports halls, promoting healthy living. Secondary care is delivered through dispersed hospitals, and tertiary care in centralised campus with specialist services, research and teaching.

Healthcare operations management problems include planning issues related to the care continuum. Brandeau, Sainfort and Pierskalla (2004) point out that these include:

(a) definition of the scope of services and its design;

(b) design and management of the healthcare supply chain e.g. network of hospitals, outpatient clinics and laboratories;

(c) planning and design of the buildings;

(d) selection of clinical equipment;

(e) planning and management of demand and capacity; and

(f) general issues like scheduling, workforce planning and job design.

Healthcare process: transformation view

Healthcare processes have been defined through a transformation view. Accordingly, inputs may include materials, equipment, technology, buildings, staff and customers, patient demands or perceived needs, other hospital providers, finances and suppliers (VISSERS; BEECH, 2005; JOHNSTON; CLARK, 2005). Outputs can be both goods and services (JOHNSTON; CLARK, 2005), health status, client perception and use of resources.

Vissers and Beech (2005) proposed three types of processes, i.e.:

(a) clinical processes including treatment modality and protocol; provider-patient encounters;

(b) management processes, including infrastructure, provider-patient encounters; and

(c) ancillary processes e.g. cleaning.

The same authors point out that outputs include health status, as well as client perception and use of resources. De Vries, Bertrand and Vissers (1999) offers a different perspective, in which hospital processes are organised around:

(a) emergency department for acute cases;

(b) outpatients department for patients that are referred for specialist consultation;

(c) diagnostic centres used by GPs for diagnostic and support services; and

(d) inpatient wards for patients requiring overnight treatment.

Furthermore, hospitals are generally organised by specialty, e.g. internal medicine, cardiology, paediatrics, etc. The physicians belonging to a specialty are specialised in treating complaints in a well-defined part of the human body, and often there are even sub-specialisations within a specialty. Similarly, hospital products have also been organised around specialty.

Consequently, it is possible to state that there is not enough clarity in the literature regarding the concepts of healthcare processes or products. There are different views about what hospital processes and products are, and taking a broader healthcare perspective, the picture seems to get even more unclear due to the myriad different healthcare configurations (BUTLER; LEONG; EVERETT, 1996; YOUNG et al., 2004).

Patient pathways: flow view

Patient pathways[2] focus on patient journeys, being defined as an "outline of anticipated care, placed in an appropriate timeframe, to help a patient with a specific condition or set of symptoms move progressively through a clinical experience to positive outcomes" (MIDDLETON; BARNETT; REEVES, 2001). Therefore, pathways represent the flow view on healthcare, in which the focus is on the patient flow through the system within a timeframe.

There are challenges in practice to disentangle actual patient pathways and obtain a clear picture of journeys that may loop back on themselves and

[2] Also referred to as care pathways

bounce across boundaries between primary and secondary care (YOUNG *et al*., 2004). The same authors describe that even though it might be possible to identify better pathways, it may not be clear how to resource it, e.g. rigorous elimination of all waiting in accident and emergency departments would free up the waiting room and triage staff and release time spent interacting with waiting patients and their friends. However, it is less clear how this extra resource could be deployed whilst ensuring that queues would not develop.

Furthermore, although processes can be relatively easily defined in a manufacturing process, those followed by individual patients depend on clinical judgments at various stages, increasing variability, which may complicate a rigorous analysis (BUTLER; LEONG; EVERETT, 1996; YOUNG *et al.*, 2004). Young *et al.* (2004) argue that some services, like maternity care, exhibit some lean characteristics, i.e. the absence of waiting lists, a strong focus on the pathways of mother and child and responsiveness to their needs. However, different illnesses and different patient types require different treatments and therefore diverse pathways. Whilst a broken rib on a young patient may require a relatively clear pathway, if the patient is elderly and suffers from different morbidities, the pathway may vary greatly.

Therefore, even though there are attempts to adopt a flow perspective in healthcare, there are a number of challenges that still need to be tacked. Once more, the links between the patient pathways and buildings in which healthcare services are delivered seems to have been abstracted away.

The patient experience: value view

From the customer's perspective, service is the combination of the customer experience and their perception of the outcome of the service. The healthcare experience is created through the way in which the patient, information and materials are processed and how they link together (JOHNSTON; CLARK, 2005). Experiences can be thought of as an outcome of a service or as a distinct economic offering, i.e. time-based or a value-added component underlying a service (ROTH; MENOR, 2003). The focus on the patient experience clearly brings value generation to the forefront of healthcare delivery.

Value generation in design is influenced by a number of different issues which are not directly related to service operations, e.g. social and cultural aspects and preferences of patient groups (e.g. the elderly, children). The improvement of the patient experience needs to consider such broader issues, as well as the quality of the environment and the services provided.

Buildings and operational efficiency and effectiveness

Research linking new buildings and operational efficiency in healthcare is scarce. One example is the work of Hejna (2004), who proposed a strategy for healthcare organisations involved in planning and implementation of facility replacement projects. The following steps are proposed:

(a) establish a clear and compelling vision and expectation for the facility project;

(b) assess current operations to identify opportunities for improvement;

(c) undertake a structured, operations-driven facility planning process;

(d) foster broad participation and ownership in the planning process; and

(e) maintain a focus on the hospital's existing strategic growth and performance improvement.

Hejna (2004) also suggested four key issues for operations driven facilities planning. The first is the definition of key operational concepts. These relate to front-end patient processes such as institution-wide plans for scheduling and registration, use of information technology, creation of service delivery zones including back and front-office aspects of the clinical care delivery model, and systems for supply acquisition and distribution. The second is the establishment of a vision and planning performance for each major functional area, considering needs and expectations of customers, scope and type of services to be offered and good practices. The third includes the design of critical processes within each major function, incorporating patient and work flows, key support processes, functional interrelationships, required physical adjacencies, and patient throughput requirements. The final issue is the identification of enablers for each major process, e.g. human resources, clinical and information technologies, organisational culture and departmental interrelationships.

The description provides a prescriptive approach to planning healthcare buildings. It is argued that such an approach might hinder the achievement of overarching process improvement as it

emphasises the design of somehow isolated functional areas in healthcare buildings. Clearly, further research is needed in the area.

Discussion

There are conceptual gaps that arise in adopting OM to healthcare, including a consideration of the extent to which patients, service providers, or even taxpayers may equate to customers in commercial settings and the way in which health outcomes, patient satisfaction, or even cost can be legitimately used to define value (YOUNG *et al.*, 2004). There is poor clarity in the literature regarding healthcare processes and products. Such clarity is required to allow for process analysis and improvement. However, healthcare can be approached and analysed from myriad perspectives, and it may be too broad a concept to allow for a specific process definition.

Moreover, service configurations in healthcare tend to be complex. Service delivery may include several loops and recovery time in some cases is poorly predictable, generating variability. Such variability affects healthcare buildings in terms of, for instance, the number of beds in a hospital. Changes of service models and technology also impact healthcare buildings, requiring greater building flexibility and adaptability (PATI; HARVEY; CASON, 2008). Questions remain however regarding how building flexibility can support a constantly changing service demand over time and how cost effective such strategy is in practice.

The role of buildings in the delivery of healthcare services is recognised in the literature. For instance, it impacts directly on patients and staff flows as well as on service configuration and patient perceptions (LAWSON, 2004). However, there are little attempts to link service design and building design.

Conclusions

This paper has explored the literature on operations management and healthcare. The discussion focused on the links between buildings design and healthcare service delivery around transformation, flow and value generation. Gaps on the knowledge have been discussed for each perspective analysed and the following research questions requiring further investigation are posed:

> *How can service and building design be more appropriately integrated?*
>
> *How developments in hospitals are defined, assessed and executed? How are requirements for such projects defined? Which stakeholders are involved? How these are managed?*
>
> *What building design decisions are more likely to influence service effectiveness?*

These questions need to be addressed through further research into the planning, design and delivery of hospital environments.

Within the literature and in practice, focus has been mainly given to the transformation view. In healthcare terms, this equates to having hospital processes and buildings which are organised around functional areas which tend to be approached as isolated functions. Such partial perspective creates barriers for building design and service innovation, and hiders the achievement of overarching improvements (e.g. increased value) from the patient perspective. Therefore, there are major challenges in achieving design for operational efficiency in practice. There is clearly a need to move from such transformation perspective towards a flow and value views on the process, as demonstrated in Figure 2.

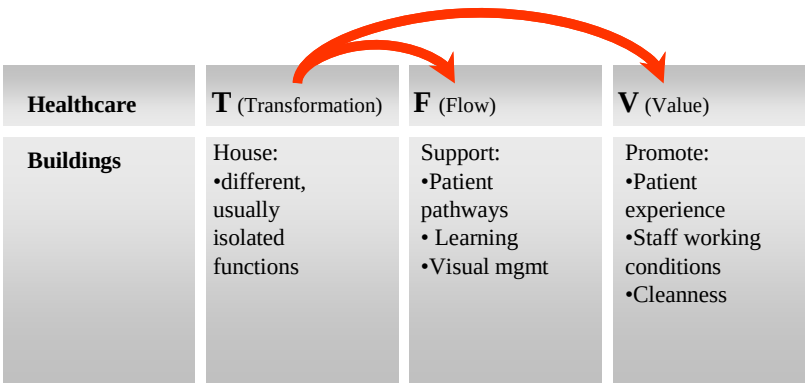

Figure 2 - **Transformation, flow and value generation in healthcare facilities – a need to move towards flow and value perspectives**

Furthermore, even though the flow and value generation perspectives do exist in healthcare, there are still poor clarity on the knowledge base and more specifically on the links between these and the built environment. For instance, from a flow perspective, healthcare services look at patient pathways, enabling organisational learning and the use of techniques like visual management. However, even though healthcare buildings should support the patient pathways, buildings seems to be abstracted away from the pathways literature. Finally, even though the patient experience has been at the forefront of many improvement initiatives, there is a need for further research into the role of the built environment in improving the patient and staff experience in healthcare. Design for operational efficiency may support achieving improvements in practice through better flows and creating patient value.

The need for a better conceptualisation of the links between healthcare service design and delivery and building design is clear. The development of a more holistic and integrated theoretical body of knowledge will offer appropriate guidance for support improvements in practice.

References

BARRETT, P; STANLEY, C. Better **Construction Briefing**. Oxford: Blackwell Science, 1999. 157p.

BERTRAND, W.; DE VRIES, G. Lessons to Be Learnt from Operations Management. In: VISSERS, J. M. H.; BEECH, R. **Health Operations Management**: patient flow logistics in healthcare. Oxon: Routledge, 2005. p. 15-38.

BOURN, J. The Provision of Out-of-Hours Care in England. **National Audit Office,** Report HC1041, 5 maio 2006.

BRANDEAU, M. L.; SAINFORT, F.; PIERSKALLA, W. P. Health Care Delivery: current problems and future challenges. In: _____. (eds.) **Operations Research and Healthcare**: a handbook of methods and applications. Dordrecht: Kluer Academic Publishers, 2004.

BRYSON, J. R.; DANIELS, P. W.; WARF, B. **Service Worlds**: people, organizations, technologies. Londres: Routledge, 2004. 286 p.

BUTLER, T. W.; LEONG, G. K.; EVERETT, L. N. The Operations Management Role in Hospital Strategic Planning. **Journal of Operations Management**, Columbus, v. 14, n. 2, p.137-156, jun. 1996.

CAMPOBASSO, F. D.; HOSKING, J. E. Two Factors in Project Success: a clear process and a strong team. **Journal of Healthcare Management,** v. 49, n. 4, p.221-225, jul./ago. 2004.

CHASE, R. B. Where Does the Customer Fit in a Service Operation? **Harvard Business Review,** v. 56, n. 6, p.137-142, 1978.

CHASE, R; APTE, U. A History of Research in Service Operations: What's the big idea? **Journal of Operations Management,** v. 25, p. 375–386, 2007.

CODINHOTO, R. *et al.* The Impacts of th Built Environment on Health Outcomes. **Facilities**, v. 27, n. 3/4, p. 138-151, 2009.

COOPER, R; JONES, T. The Interface Between Design and Other Key Functions in New Product Development. In: BRUCE, M.; BIEMANS, V. (ed.). **New Product Development.** Nova York: Wiley and Sons, 1995.

DAVIS, M. M.; HEINEKE, J. **Operations Management**: integrating manufacturing and services. New York: McGraw-Hill Irwin, 2005.

DE VRIES, G.; BERTRAND, J. W.; VISSERS, J. M. H. Design Requirements for Health Care Production Control Systems. **Production Planning and Control,** v. 10, n. 6, p. 559-569, 1999.

DUBE, L.; JOHNSON, M. D.; RENAGHAN, L. M. Adapting the QFD Approach to Extended Service Transactions. **Production and Operations Management**, v. 8, n. 3, p. 301-317, 1999.

EVANS, G. W.; MCCOY, J. M. When Buildings Don't Work: the role of architecture in human health. **Journal of Environmental Psychology**, Victoria, v. 18, n. 1, p. 85-94, mar. 1998.

FITZSIMMONS, J. A.; FITZSIMMONS, M. J. **Service Management**: operations, strategy, and information technology. Nova York: Irwin/McGraw-Hill, 2004.

FRANCIS, S. The Architecture of Health Buildings: providing care: can architects help? **The British Journal of General Practice,** v. 52, n. 476, p. 254-255, mar. 2002.

GESLER, W. B. M. *et al.* Therapy by Design: evaluating the UK hospital Building program. **Health and Place**, v. 10, n. 2, p. 117-128, jun. 2004.

HEAD, S. **The New Ruthless Economy**: work and power in the digital economy. Nova York: Oxford University Press, 2003.

HEJNA, W. Five Critical Strategies for Achieving Operational Efficiency. **Journal of Healthcare Management**, v. 49, n. 5, p. 298-292, set./out. 2004.

JOHNSTON, R.; CLARK, G. **Service Operations Management**: improving service delivery. Harlow: Prentice Hall, 2005.

KOSKELA, L. J. **An Exploration Towards a Production Theory and its Application to Construction**. 2000. 298 f. Tese (Dissertação de PhD). Finlândia, Epooo, VTT Publications 408, 2000.

KOSKELA, L. J.;HOWELL, G. The Underlying Theory of Project Management Is Obsolete'. **Engineering Management Review**, v. 36, n. 2, p. 22-34, abr./jun. 2008.

KOSKELA, L.; KAGIOGLOU, M. On the Metaphysics of Production. In: ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION, 19., 2005. Sydney. **Proceedings...** Sydney: IGLC, 2005. p. 37-46. Disponível em: <http://www.iglc.net/conferences/2005/papers/session01/05_059_Koskela_Kogioglou.pdf>. Acesso em: 05 set. 2007.

LAWSON, B. Assessing Benefits in the Halth Sctor. In: MACMILAN, Sebastian. (ed.). **Designing Better Buildings**: quality and value in the built environment. Routledge: Spon Press, 2004. p. 100-106.

LI, L. X.; BENTON, W.; LEONG, G. K. Impact of Strategic Operations Management Decisions on Community Hospital Performance. **Journal of Operations Management**, v. 20, n. 4, p. 389-408, ago. 2002.

LIKER, J. **The Toyota Way**: 14 management principles from the world's greatest manufacturer. Nova York: McGraw-Hill, 2004. 364 p.

LINCOLN, Y.; GUBA, E. **Naturalistic Inquiry**. Londres: Sage, 1985. 416 p.

MANGO, P.; SHAPIRO, L. Hospitals Get Serious About Operations. **The McKinsey Quarterly**, v. 2, p. 74-85, maio 2001.

MIDDLETON, S.; BARNETT, J.; REEVES, D. What is an Integrated Care Pathway? **Evidence-Based Medicine**, v. 3, n. 3, p. 01-07, 2001.

OLIVA, R.; KALLENBERG, R. Managing the Transition from Products to Services. **International Journal of Service Industry Management**, v. 14, n. 2, p. 160–172, 2003.

PATI, D.; HARVEY, T.; CASON, C. Inpatient Unit Flexibility: design characteristics of a successful flexible unit. **Environment and Behaviour**, v. 40, n. 2, p. 205-232, 2008.

ROTH, A.; MENOR, L. Insights Into Service Operations Management: a research agenda. **Production and Operations Management**, v. 12, n. 2, p.145-164, 2003.

SHOSTACK, G. Designing Services that Deliver. **Harvard Business Review**, v. 62, n. 1, p. 133–139, 1984.

SHOSTACK, G. Service Positioning through Structural Change. **Journal of Marketing**, Chicago, v. 51, p. 34-43, jan. 1987.

TZORTZOPOULOS, P. *et al.* Clients' Activities at the Design Front-End. **Design Studies**, v. 27, n. 6, p. 657-683, nov. 2006.

ULRICH, R. *et al.* The Role of the Physical Environment in the Hospital of the 21st Century: a once-in-a-lifetime opportunity. Concord: Center for Health Design, 2004.

VISSERS, J.; BEECH, R**. Health Operations Management: patient flow logistics in healthcare**. Londres: Routledge, 2005. 322 p.

YOUNG, T. *et al.*Using Industrial Processes to Improve Patient Care. **British Medical Journal**, v. 328, n. 17, p.162-164, jan. 2004.